

SECTION 6

FIELD OBSERVATIONS

The purpose of this section is to summarize interim field observations made during the construction and operation of the Unit 5 and Unit 7 landfill bioreactor cells. These observations are from Mr. Tony Barbush, co-Principal Investigator, and Mr. Gary Hater, Project Manager, each an WMI employee with responsibilities for permitting, construction, and ongoing operations at the Outer Loop Facility. Selected photographs are provided in Appendix A to provide the reader with some insight of the site conditions and construction of project elements.

It is recognized that these observations are general in nature and are not supported by experimental field data as might be presented in a technical or scientific manner. Moreover, such observations may not be applicable at other landfill sites due to many variables.

Lack of supporting documentation and applicability might suggest that such observations should be excluded from this interim research report. However, full-scale trials of landfill bioreactor technologies are not common in the United States or in the published literature. Landfill owners and operators in the industry have little guidance as to what field techniques, practices, and procedures have merit with respect to the objectives of this and similar projects. As a result, this section has been included to contribute to the knowledge base of landfill operators seeking to explore the use of landfill bioreactor techniques and practices.

Four topics for field observation are discussed herein:

- Tire chips as part of cell construction
- Air addition to enhance aerobic degradation
- Landfill gas collection performance
- Moisture Addition Amounts

TIRE CHIPS AS PART OF CELL CONSTRUCTION

The use of tire chips was integrated into the construction of landfill bioreactor cells Units 5 and 7, generally for purposes of aggregate and replacement of gravel or stone where practical. During the cell construction period, WMI received over 20,000 tons of tire chips (less than 3-inch [1.935 mm²] pieces), equivalent to some 2.4 million tires, for pipe bedding, hydraulic separation of adjacent cells, and as part of a protection layer atop the leachate collection system.

As pipe bedding, the tire chips were placed into trenches as part of the installation of perforated pipe used for the reintroduction of air, leachate or other moisture, and for landfill gas collection. Depending on the cell, trenches were either 3-feet or 15-feet deep, with varying bedding layers, piping runs, and instrumentation installations. Field observations suggest that these tire chips work well for pipe bedding in terms of the intended design. Performance of the

tire chips may be reduced if there is significant vertical height of waste above the piping and subsequent compression loading. Field observations suggest that HDPE pipe SDR 17 (standard dimension ratio) performance is better when bedded in tire chips with less than approximately 75 feet of vertical waste height. This performance was confirmed, at least in part, through television inspection of such pipes (4-inch diameter) at the Outer Loop facility. At greater vertical waste heights, field observations suggest that either the bedding material must be changed (e.g., to gravel or glass cullet) or the piping must be changed to SDR 11.

In lieu of geomembranes or other impermeable materials, a 6- to 12-inch tire chip layer was used in conjunction with a 12-inch clay layer to construct hydraulic separation barriers between research cells. As the various cells were filled, this barrier was installed to retain leachate and infiltration moisture within the test cells, and to reduce/prevent landfill gas migration from other cells into the test cells.

A one-foot thick layer of tire chips was placed atop the leachate collection system as a protective material. This allowed the overall protective layer of placed refuse to be reduced to four feet from 10 feet.

AIR ADDITION TO ENHANCE AEROBIC DEGRADATION

The addition of air into Unit 7.4 was accomplished on an intermittent basis during the air addition phase of the program design. Landfill gas blowers were used primarily, along with an air compressor (or both) on some occasions. Rates of air addition into buried perforated pipe varied from approximately 200 scfm to 1,000 scfm, dependent on the waste lift and waste temperature, as well as on waste moisture and air permeability. For example, during the period of April 18, 2002 through April 1, 2003, lifts in Cell 7.4A were aerated for over 2,000 hours; lifts in Cell 7.4B were aerated for just over 600 hours, using only the blowers.

As discussed earlier in this report, significant attention was given to the placement and number of temperature probes. Even so, some 10 percent of the installed probes appeared to fail with time.

Waste temperature rise was used as a key measure to stop or reduce air addition. Field procedures called for evaluating continued air in the cells if any waste temperature probe reached 80° C, or if after reaching 60° C, a temperature probe increased by 10° C or more during any 48-hour period. Moisture additions were to be used, where warranted, to cool the in-place waste. Field observations and measurements suggested that these procedures avoided excessive temperatures that might lead to a subsurface fire situation. Over the period of treatment discussed herein, waste temperature exceedances did not occur and thus, aeration was not suspended nor was moisture addition prescribed for cooling the waste.

With the introduction of air into the landfill, no impacts were observed on fugitive landfill gas emissions. That is, no exceedances of regulatory thresholds were encountered before or after the period of aeration treatment from surface emissions monitoring.

LANDFILL GAS COLLECTION AND PERFORMANCE

Moisture additions called for in the program design appeared to have an impact on landfill gas collection performance. Significant LFG generation was able to be captured in the leachate risers, leading to the need to valve the riser vaults and cleanouts and improve overall collection. Horizontal landfill gas collectors appeared to work as designed; the exception to this was during rain surges where on occasion, the piping and bedding materials flooded temporarily. In Unit 5 where vertical wells were used, field experience indicated that the installation of in-place pumps was useful to prevent watering out of some landfill gas wells.

MOISTURE ADDITION AMOUNTS

Moisture additions called for in the program design were accomplished on an intermittent basis, dependent on several daily and seasonal factors, as well as operator judgments. Apparent moisture content of the as-received waste, moisture content of expected waste loads, received and forecasted precipitation, recent moisture additions (including leachate) and other considerations, were taken into account so as to achieve good waste infiltration while avoiding leachate outbreaks, seeps, and reduced performance of landfill gas collection wells due to excessive moisture.

Field observations on this project suggest that the removal of low permeability cover layers and paved haul roads prior to moisture addition can reduce or minimize sideslope seepage. In addition, placement of large volumes of non-permeable waste soils or similar materials should be directed away from the center of an operating cell, where practical, so as to manage moisture flow away from sideslopes.

Conceptually, a lower in-place waste density will allow greater volumes of moisture addition than a higher initial waste in-place density, other factors being equal. Field observations on this project suggest that this basic relationship holds. Consequently, basic guidance can be developed for moisture addition to in-place refuse when the initial in-place density can be calculated and the approximate area (footprint) of the cell is known.

This guidance is summarized in the below Figure 6-1, and provides a general calculated approach to the amount of moisture that can be added initially on a daily basis, relative to the surface area of the landfill cell. Based on field observations at the Outer Loop facility, moisture addition is an approximate linear relationship and not necessarily depth dependent. Note that a performance benchmark can be developed (termed the Airspace Utilization Factor, as discussed in Section 5) based on the calculated in-place waste density (wet) compared to the desired or target density (wet) to be achieved.

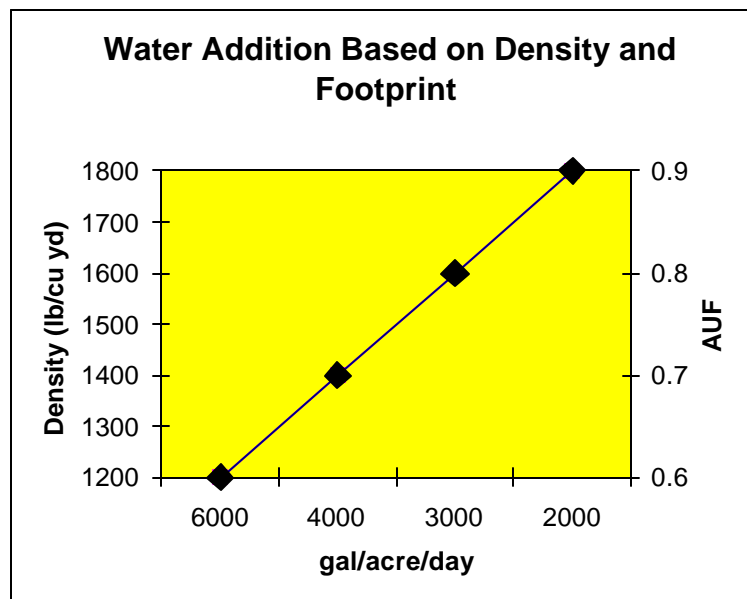


Figure 6-1. Water Addition Based on Density and Footprint

For example, suppose an operator intends to operate a new 10-acre landfill cell as a bioreactor through moisture addition and wetting of the waste at the working face. At the time of initial moisture addition, the calculated in-place density is approximately 1,400 lbs of refuse per cubic yard. Based on the above table, approximately 4,000 gallons per acre per day (or 40,000 gallons per day), can be added during dry working conditions at the onset. The field experience at the Outer Loop facility suggests this amount would not/did not result in leachate seeps or outbreaks. Moisture addition would be limited to the working face area, the operating deck, and/or, if installed, subsurface piping of some kind.